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Five penzigioid Xylaria species from Veracruz (Mexico)

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Abstract—Five species of the genus *Xylaria* with penzigioid stromata were collected from the state of Veracruz, Mexico. *Xylaria albocinctoides*, *X. discolor*, and *X. xylarioides* are new records for the Mexican mycobiota; *X. frustulosa* is a new record for Veracruz State; and *X. berteroi* is recorded from new localities within the state. Photographs of the stromata of the five species are presented, as well as a dichotomous key to the penzigioid *Xylaria* species known in Mexico.

Key words—*Ascomycota*, taxonomy, chorology

Introduction

Xylaria Hill ex Schrank is the type genus of the family *Xylariaceae*, with approximately 300 species (Kirk et al. 2008), some of which are characterized by penzigioid stromata. Penzigioid *Xylaria* were once placed in *Penzigia* Sacc., but Ju & Rogers (2001) showed that the type species, *P. cranioides* Sacc. & Paol., belongs to *Xylaria*. There are more than 40 penzigioid *Xylaria* species worldwide (Ju et al. 2012), characterized by sessile stromata and adherence to the substrate by a narrow central connective.

San Martín & Rogers (1995) recorded 105 *Xylaria* species in Mexico. Of the 109 species listed by Medel (2007), 45 are from Veracruz State (Medel et al. 2008). Penzigioid *Xylaria* species previously known from Mexico include *X. anisopleura* (Mont.) Fr., *X. berteroi*, *X. boergesenii* (Ferd. & Winge) P.F. Cannon, *X. enteroleuca* (J.H. Mill.) P.M.D. Martin, and *X. frustulosa* (San Martín & Rogers 1995). Chacón & Guzmán (1983) recorded "*Penzigia*

conostoma" (a name they attributed to J.H. Miller) from Veracruz, but Miller's (1961) "*Hypoxylon conostomum*" is a misdetermination of *X. boergesenii* (fide Cannon 1987).

The present study contributes to a better understanding of *Xylaria* species with penzigioid stromata from Veracruz State.

Materials & methods

We examined approximately 50 specimens of *Xylaria* with penzigioid stromata (all from localities in central Veracruz State), of which most were collected by the authors and a few are collections made by others and deposited at the Herbarium, Instituto de Ecología, A.C., Xalapa, Mexico (XAL). The stromata were sectioned and mounted in 5% KOH or Melzer's reagent. Descriptions are given for *X. albocinctoides*, *X. discolor*, and *X. xylarioides* (newly recorded from Mexico) and for *X. frustulosa,* not previously described based on Mexican material. Photographs of stromata are presented. All of the studied specimens were dried, labelled, and deposited at XAL, and duplicates were deposited at the Herbarium, Biodiversity Research Center, Academia Sinica, Taipei, Taiwan (HAST).

Taxonomy

Xylaria albocinctoides Y.M. Ju, H.M. Hsieh & J.D. Rogers,
Mycologia 104: 768 (2012) PLATE 1A

STROMATA superficial, gregarious, aggregated to dispersed, sometimes confluent, semicircular, flattened to pulvinate, occasionally subglobose, reddish brown to blackish brown, slightly shiny, 0.5–2 mm diam × 0.5–0.8 mm thick, ≤10 mm long when confluent, attached to substrate by a narrow central connective, with 4–20 perithecia enclosed within each stroma, with white interior. PERITHECIA globose to subglobose, 0.2–0.3 mm diam. OSTIOLES black, papillate, 0.1 mm broad, slightly raised. ASCI with eight ascospores arranged in uniseriate manner, hyaline, cylindrical, 150–170 × 12–16 µm, with an amyloid apical ring. ASCOSPORES (18–)19–23 × 10–12 µm, dark brown to blackish brown, ellipsoid, inequilateral, somewhat rounded at ends, with a straight germ slit spore-length.

HABITAT—On dead branches of *Piper* sp. and secondary vegetation in a montane cloud forest at altitudes between 1300 and 1550 m.

SPECIMENS EXAMINED—**MEXICO, VERACRUZ STATE, Municipality of Xalapa,** Cerro Macuiltepec Ecological Park, 9 August 2011, S. Chacón, E. Utrera & F. Tapia 6204; 6 September 2011, S. Chacón & F. Tapia 6349; 27 September 2011, S. Chacón & F. Tapia 6387, 6388; 11 October 2011, S. Chacón & F. Tapia 6461; 25 October 2011, S. Chacón & F. Tapia 6533; 6 March 2013, S. Chacón & F. Tapia 6945; 10 April 2013, S. Chacón 7055-B; 11 July 2013, S. Chacón & F. Tapia 7207; 30 July 2013, S. Chacón & F. Tapia 7290; 5 August 2014, Chacón & F. Tapia 7699; INECOL Cloud Forest Sanctuary, Km 2.5

old road Xalapa–Coatepec, 25 August 2010, S. Chacón & E. Utrera 5929; 9 September, 2010, S. Chacón, E. Utrera & M. Soto 5970; 24 November 2010, S. Chacón & E. Utrera 6176; 22 August 2011, S. Chacón & E. Utrera 6246; 26 August 2011, S. Chacón, F. Tapia & E. Utrera 6292; 14 October 2011, S. Chacón 6477; 21 October 2011, S. Chacón & F. Tapia 6522; 28 October 2011, S. Chacón & F. Tapia 6546; 3 April 2014, F. Tapia 3008; 17 May 2012, S. Chacón & F. Tapia 6790-B; Tecajetes Park, 3 July 2013, S. Chacón, F. Tapia & E. Utrera 7154; Francisco Javier Clavijero Ecological Park, Km 2.5 old road Xalapa–Coatepec, 8 December 2003, S. Chacón 5506.

Remarks—*Xylaria albocinctoides* is a penzigioid species with a thin, soft stromatal surface. Macroscopically it is similar to *X. albocincta* (Rehm) Y.M. Ju et al., which differs mainly by larger ascospores 27–32 × 12–14 µm. The Mexican *X. albocinctoides* specimens have ascospore measurements very similar to those given in Ju et al. [2012; (18–)19–21(–22.5) × 10–11.5 µm]. *Xylaria albocinctoides,* previously known only from Venezuela, represents a new record for Mexico and is the most frequently encountered penzigioid *Xylaria* species recorded from Veracruz.

Xylaria berteroi (Mont.) Cooke ex J.D. Rogers & Y.M. Ju,
N. Amer. Fung. 7(9): 18 (2012) Plate 1B

= *Penzigia enteroleuca* J.H. Mill., Mycologia 32: 183 (1940)

Habitat—On dead wood of angiosperms in a montane cloud forest, in a coffee farm within a secondary vegetation at altitudes of 1300 to 1600 m.

Specimens examined—**MEXICO, Veracruz State, Municipality of Xalapa,** San Roque Hills, 8 August 2012, F. Tapia & S. Chacón 2615; INECOL Cloud Forest Sanctuary, Km 2.5 old road Xalapa–Coatepec, 3 September 2010, S. Chacón & E. Utrera 5948; 1 October 2010, S. Chacón & E. Utrera 6049; 14 October 2011, S. Chacón & F. Tapia 6473; 6 June 2013, S. Chacón 7103; 19 June 2013, S. Chacón & F. Tapia 7109, 7128; 2 July 2013, S. Chacón & F. Tapia 7147, 8 August 2013, S. Chacón, E. Utrera & F. Tapia 7342, 7349; Natura Park protected area, 8 October 2011, S. Chacón & F. Tapia 6502; 27 February 2013, S. Chacón 6930; 3 April 2013, S. Chacón 7008, 7009, 7012, 7015, 7021; 19 July 2013, S. Chacón & F. Tapia 7233; Francisco Javier Clavijero Ecological Park, Km 2.5 old road Xalapa–Coatepec, 12 May 1982, Brown 416; 8 June 1983, S. Chacón 1068; 12 December 1983, S. Chacón 1934; 7 May 1986, L. Montoya 530; 23 March 1987, R. Medel 329; Francisco Javier Clavijero Botanical Garden, Km 2.5 old road Xalapa–Coatepec, 17 July 1991, S. Chacón 4519; 9 August 1995, S. Chacón 4925; 14 June 2000, R. Medel 756; 11 September 2006, R. Medel 1315; 2 September 2011, S. Chacón & E. Utrera 6331; 2 July 2012, F. Tapia 2576; 24 October 2012, F. Tapia 2691; Around the child care house CONECALLI, Km 2.5 old road Xalapa–Coatepec, 3 December 1990, F. Tapia 431; Cerro Macuiltepec Ecological Park, 6 September 2011, S. Chacón 6349-A; 27 September 2011, S. Chacón & F. Tapia 6390; 6 March 2013, S. Chacón 6935, 6948; 10 April 2013, S. Chacón 7065; 11 July 2013, S. Chacón & F. Tapia 7204, 7208; 30 July 2013, S. Chacón & F. Tapia 7279, 7285. **Municipality of San Andrés Tlalnehuayocan,** Agüita Fría Ranch, 6 April 2007, R. Medel 1351. **Municipality of Acatlán**, top Acatlán Volcano, 2 October 2013, S. Chacón, F. Tapia & E. Utrera 7419. **Municipality of Coatepec,** about 1 km of the road Coatepec–El Grande, 23 October 2012, F. Tapia 2686-B.

Remarks—*Xylaria berteroi* can be diagnosed by its more or less pulvinate to discoid stromata (0.7–2.5 cm diam × 0.2–0.7 cm thick), a thick hard carbonaceous outer stromatal layer (sometimes cracked on the surface), and ascospores [(9–)12–13.5(–14) × (6–)6.5–7.5(–8) µm] with a straight germ slit running almost the entire ascospore length. Welden et al. (1979) and Medel & Chacón (1997) reported *X. berteroi* from Veracruz State, and our research extends its known distribution to other localities in central Veracruz. The specimen "Brown 416", cited by Chacón & Guzmán (1983) as *Penzigia enteroleuca,* corresponds to *X. berteroi;* these two species are difficult to separate—Callan & Rogers (1990) suggested that they are probably conspecific, and Rogers & Ju (2012) treated them as conspecific.

Xylaria discolor (Berk. & Broome) Y.M. Ju, H.M. Hsieh, J.D. Rogers & Jaklitsch, Mycologia 104: 772 (2012) Plate 1C,D

= *Penzigia bermudensis* J.H. Mill., Mycologia 32: 402 (1940)

Stromata erumpent to superficial, dispersed, gregarious to confluent, subglobose to pulvinate, sometimes flattened, whitish grey to dark grey due to the presence of a outer layer, which falls off with age, leaving the surface a dark brown to blackish brown, 0.3–2 mm diam. × 0.5 mm thick, ≤1.5 cm long when confluent, attached to the substrate by a narrow central connective, containing ≤25 perithecia per stroma; surface dotted with ostioles; interior soft, yellow, whitish towards the base. Perithecia globose to subglobose, 0.1–0.3 mm diam. Ostioles black, papillate, 0.1 mm broad, slightly raised. Asci with eight uniseriately arranged ascospores, hyaline, cylindrical, 90–140 × 8–10 µm, with an inamyloid apical ring. Ascospores dark brown to blackish brown, ellipsoid, equilateral, with rounded apices, (8–)9–12 × 5.5–7.5(–8) µm, with a straight, spore-length germ slit.

Habitat—On dead wood in a montane cloud forest and in secondary vegetation of an abandoned coffee plantation. Altitudes 1300 to 1450 m.

Specimens examined—**MEXICO, Veracruz State, Municipality of Xalapa,** Francisco Javier Clavijero Botanical Garden, Km 2.5 old road Xalapa–Coatepec, 7 October 2010, S. Chacón & E. Utrera 6076; Palo Verde pantheon of Xalapa, 21 March 2012, S. Chacón 6984; Cologne El Olmo, former hacienda Las Animas, 17 April 2013, S. Chacón 7092; Cerro Macuiltepec Ecological Park, 28 August 2014, S. Chacón & F. Tapia 7783.

Remarks—Macroscopically *X. discolor* is somewhat similar to *X. lechatii* Y.M. Ju et al., but the latter species has a white interior, an apical ring staining pale blue only at base in Melzer's iodine reagent and larger ascospores 12–15 × 6.5–8 µm. According to Ju et al. (2012) and Rogers & Ju (2012), *Penzigia bermudensis* is a synonym of *X. discolor*. Seaver & Waterston (1940) described *P. bermudensis* with ascospores of 8–10 × 6–8 µm; our measurement of the

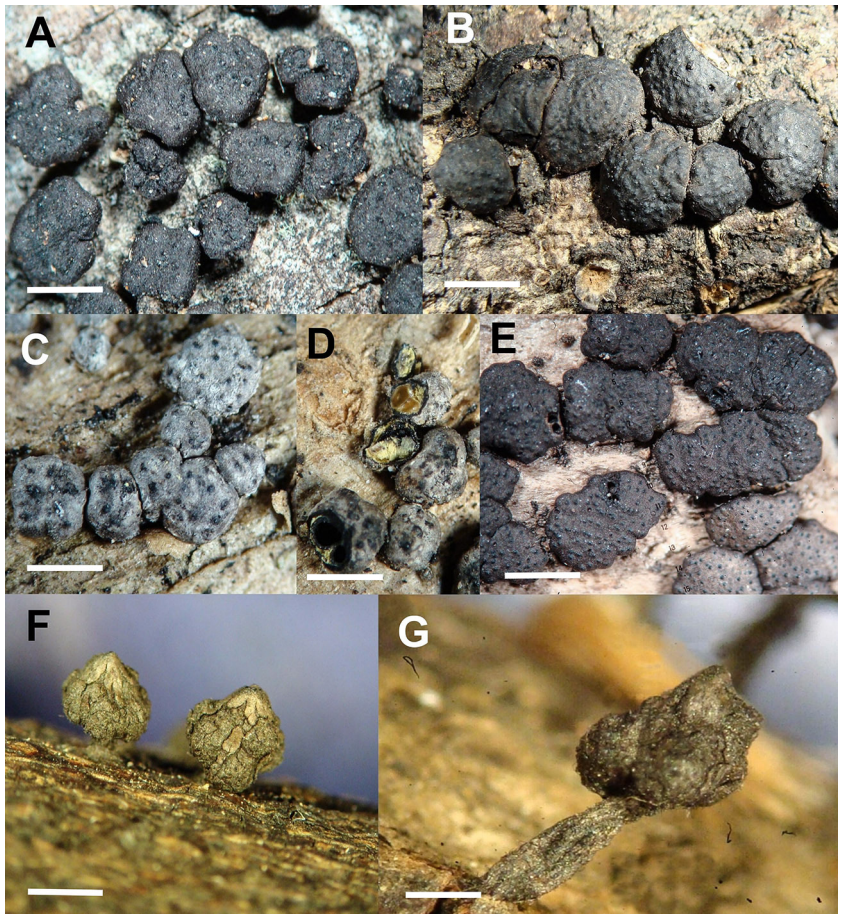

Plate 1. Stromata of *Xylaria* species. ***X. albocinctoides:*** A. scale bar = 2 mm. ***X. berteroi:*** B. scale bar = 7 mm. ***X. discolor:*** C. scale bar = 1.3 mm, D. scale bar = 1 mm. ***X. frustulosa:*** E. scale bar = 1.5 mm. ***X. xylarioides:*** F. scale bar = 1 mm, G. scale bar = 0.7 mm.

Mexican *X. discolor* ascospores agrees with those in Ju et al. (2012); (8.5–)9–12 × 5.5–7(–7.5) µm and Rogers & Ju (2012; 9–10.5 × 6–8 x 5–6 µm). This is the first record of *X. discolor* from Mexico.

Xylaria frustulosa Y.M. Ju, H.M. Hsieh & J.D. Rogers, (Berk. & M.A. Curtis) Cooke, Grevillea 12: 5 (1883) Plate 1E

≡ *Sarawakus frustulosus* (Berk. & M.A. Curtis) Lar. N. Vasiljeva, Nizshie Rasteniya, Griby i Mokhoobraznye Dalnego Vostoka Rossii 4: 157 (1998)

Stromata superficial, gregarious to confluent, semicircular to irregular, flattened to pulvinate, dark brown to black-brown, 0.5–2.7 mm diam. × 0.5–0.8 mm thick, ≤8 mm long when confluent, attached to the substrate by a narrow central connective, containing numerous perithecia; surface dotted with ostioles; interior soft, white. Perithecia globose to subglobose, 0.1–0.2 mm diam. Ostioles black, papillate, 0.1 mm wide, slightly raised. Asci with eight ascospores, hyaline, cylindrical, 40–50 × 4–6 µm, with a long stipe, and a small amyloid apical ring. Ascospores pale greenish brown, elliptical, 5–6(–7) × 2–3 µm, with an inconspicuous germ slit.

Habitat—On decorticated wood in a *Mangifera indica* plantation, alt. 500 m.

Specimen examined—**MEXICO, Veracruz State, Municipality of Jalcomulco,** beside restaurant El Rey, road Tlaltetela–Xalapa, 6 October 2012, S. Chacón 6869-B.

Remarks—*Xylaria frustulosa* is characterized mainly by its subdiscoid confluent stromata with small (no more than 0.8 mm) diameters and small ascospores with barely discernible germ slits. The ascospore size range of the Mexican material in general agrees that given by Miller (1934), Dennis (1970), Martin (1970), Jong & Rogers (1970), and Ju et al. (2012). The combination of this species in *Sarawakus* Lloyd (Vasilyeva 1998) is untenable; *Sarawakus* has a hypocrealean type species and is considered to be a synonym of *Trichoderma* (Samuels & Rossman 1992, Jaklitsch et al. 2014).

Xylaria frustulosa is known from tropical and subtropical regions in the Americas and Asia. San Martín & Rogers (1996) cited *X. frustulosa* (without a description) from Tamaulipas State, Mexico. Our collection represents the first record of *X. frustulosa* from Veracruz State.

Xylaria xylarioides (Speg.) Hladki & A.I. Romero,
Fungal Diversity 42: 86 (2010) Plate 1F, G

Stromata solitary to gregarious, the fertile part conical to subrhomboid or subcylindrical, 0.8–3 × 0.6–2 mm, with perithecial contours well pronounced and with the apex conical and sterile, sessile or sometimes with a short stipe ≤1.5 mm long, tomentose, concolorous with the fertile part; peeling layer arranged in pale brown bands, running from apex to middle. Perithecia globose to subglobose, 0.2–0.7 mm diam. Ostioles shiny black, papillate, small, up to 0.1 mm diam; surface roughened, black to blackish brown; interior soft, white. Asci containing eight uniseriately arranged ascospores, hyaline, cylindrical, 140–195 × 8–9 µm, with an amyloid apical ring. Ascospores brown to blackish brown, ellipsoid to navicular, inequilateral, with apices more or less rounded or mucronate, (17–)19–22 × (6.5–)7–9.5 µm, with a straight germ slit running almost the entire spore length.

Habitat—On dead branches of unidentified angiosperms, in a montane cloud forest and natural secondary vegetation at altitudes of 1300 to 1600 m.

Specimens examined—**MEXICO, Veracruz State, Municipality of Xalapa,** Cerro Macuiltepec Ecological Park, 11 October 2011, S. Chacón & F. Tapia 6459; 11 July 2013, S. Chacón 7199; INECOL Cloud Forest Sanctuary, Km 2.5 old road Xalapa–Coatepec, 30 September 2011, S. Chacón & E. Utrera 6419; S. Chacón & F. Tapia 6420; Tecajetes Park, 1 August 2013, S. Chacón, E. Utrera & F. Tapia 7305; Francisco Javier Clavijero Ecological Park, Km 2.5 old road Xalapa–Coatepec, 24 April 2014, F. Tapia & S. Chacón 3023.

Remarks—This species is characterized by the presence of a conical sterile apex, a well–developed peeling layer, and ascospore size and shape. The Mexican material agrees with the description of Hladki & Romero (2010; ascospores 17–21 × 6.5–9 µm). The Mexican material of *X.* x*ylarioides* shows a great variability in stipe length; in some collections the stipe is almost indiscernible but in others it reaches up to 3 mm long.

Dichotomous key to penzigioid *Xylaria* species in Mexico

1. Apex of the stromata conical, sterile; ascospores 17–22 × 6.5–9.5 µm ..... *X. xylarioides*
1. Apex of stromata flattened or convex, fertile 2
2. Ascospores >20 µm long 3
2. Ascospores <20 µm long 4
3. Stromata flattened to pulvinate 6
3. Stromata subglobose to elongate, 0.4–4 cm high; ascospores 20–30 × 7.5–9.5 µm ..... *X. anisopleura*
4. Stromata 1–2 cm diam, with a carbonaceous outer layer; ascospores 9–14 × 6–8 µm ..... *X. berteroi*
4. Stromata 0.5 mm diam, with a thin and soft outer layer 5
5. Stromatal interior yellow; ascospores 8–12 × 5.5–8 µm ..... *X. discolor*
5. Stromatal interior white; ascospores 5–7 × 2–3 µm ..... *X. frustulosa*
6. Ascospores 18–23 × 10–12 µm, with a straight germ slit ..... *X. albocinctoides*
6. Ascospores 19.5–26 × 7–8.5 µm, with a spiral to sigmoid germ slit ... *X. boergesenii*

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